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TESTING CROSS-LAGGED RELATIONSHIPS BETWEEN WORK-RELATED RUMINATION
AND WELL-BEING AT WORK IN A THREE-WAVE LONGITUDINAL STUDY ACROSS ONE
AND TWO YEARS

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Abstract

The aim of this three-wave longitudinal study conducted among 664 Finnish employees was to examine the cross-lagged relationships between various work-related ruminative thoughts (affective rumination, problem-solving pondering, lack of detachment from work) during off-job time and employee well-being (exhaustion, vigour). We tested normal, reversed and reciprocal temporal relationships across one and two years using structural equation modelling. The analyses lent most support to the reversed temporal relationships showing first that high exhaustion predicted low problem-solving pondering two years later and second, that high vigour predicted low affective rumination both one year and two years later. In addition, a normal temporal relationship was supported in one model indicating that high affective rumination predicted high exhaustion one year later. Thus our study suggests that affective ruminative thoughts in particular play a negative role in cross-lagged relationships. On the basis of our results occupational health interventions intended to reduce both affective work-related rumination and exhaustion, and to increase vigour at work are desirable.

Key words: detachment, exhaustion, pondering, recovery, rumination, vigour

Practitioner points:

- Affective rumination during off-job time predicted increased job exhaustion across one year. Prevent affective rumination by training employees to change ways of thinking and to create action plans on setting and completing work goals.
- Vigour predicted reduced affective work-related rumination in the long-term. Provide employees with sufficient job resources to increase their vigour at work.
- Exhaustion predicted reduced problem-solving pondering during off-job time in the long-term. Attention should be paid to ensuring that job demands are not so high that they increase exhaustion. Care should be taken to ensure that problem-solving pondering replenishes energy resources.

Testing cross-lagged relationships between work-related rumination and well-being at work in a three-wave longitudinal study across one and two years

It has been consistently suggested that insufficient recovery from work, especially over extended periods of time, results in resource depletion and impairs employees' well-being (Cropley & Zijlstra, 2011; Geurts & Sonnentag, 2006; Sonnentag, Venz, & Casper, 2017). However, longitudinal evidence on these expected long-term detrimental effects on employee well-being is scarce, as the current knowledge base mainly consists of findings from cross-sectional studies together with diary studies (see Bennett, Bakker, & Field, 2018; Wendsche & Lohmann-Haislah, 2017, for meta-analyses). This is an important research gap; only longitudinal research encompassing prolonged time periods can provide appropriate information about the (lagged) associations between recovery and employee well-being. Additionally, longitudinal research can help to disentangle the temporal order of the associations. That is, to test whether insufficient recovery has a lagged effect on poor well-being or conversely whether poor well-being has a lagged effect on insufficient recovery. A lagged effect occurs when the effect takes time to develop, and it is operationalized as the extent to which a variable at one point in time predicts another variable at a later point in time, controlling for its baseline level (Ford et al., 2014). Thus studying lagged effects is an important step forward in recovery research and has been urgently called for (e.g., Sonnentag et al., 2017). In our study we examine the lagged effects of one and two years between (in)sufficient recovery (in terms of work-related rumination) and well-being outcomes (exhaustion and vigour at work).

Effort-recovery theory (Meijman & Mulder, 1998) suggests that people must invest mental and physical resources to deal with work-related demands. This investment results in a depletion of resources and "a need to recover" (van Veldhoven, 2008). Recovery will only occur if the depleted systems are no longer taxed during off-job time (Meijman & Mulder, 1998). Therefore, one factor that

is critical in the facilitation of adequate recovery is psychological detachment from work during time off the job. Psychological detachment refers to “an individual’s sense of being away from the work situation” (Etzion, Eden, & Lapidot, 1998, p. 579) and implies refraining from job-related activities and mentally disengaging from work during time off the job (Sonnentag & Fritz, 2007, 2015). However, during off-job time people may ruminate, that is, think about work-related issues, demands and events (Querstret & Cropley, 2012). Some people think about tasks they have left uncompleted, others ruminate about a problem that needs to be solved, and others’ attention is mainly directed to feelings related to work problems (Cropley & Zijlstra, 2011; Syrek & Antoni, 2014). According to effort-recovery theory, this kind of thinking may jeopardize recovery from work. In the present study, we approach work-related rumination broadly, covering its different facets: affective rumination, problem-solving pondering, (lack of) detachment.

Our study contributes to the recovery and rumination literature in four ways. First, the longitudinal design contributes to a better understanding of the long-term relationships between work-related rumination and employee well-being. More specifically, we can study normal (i.e., the typical, theory-based temporal pattern explored in studies), reversed and reciprocal effects between work-related rumination and employee well-being. Second, using three measurement points with a one-year time lag we are able to test the lagged relationships across one and two years. To employ several time points in measurements is considered important when the appropriate time lag is unknown (Kelloway & Francis, 2013; Taris & Kompier, 2014) – as in our case. Although the appropriate length of the time lag between measurements is a crucial issue in longitudinal research (Dormann & Griffin, 2015), we seldom know the correct underlying time lag needed to show the lagged effects. Third, we define work-related rumination broadly including affective rumination, problem-solving pondering and lack of detachment from work (Cropley & Zijlstra, 2011). Therefore our study can show whether there are differential effects of various forms of ruminative thoughts on employee well-being. The present study

examines the idea that, depending on the type of rumination, work-related rumination may not necessarily be a factor detrimental to recovery and well-being. Fourth, our study also contributes to the study of employee well-being. We examine job exhaustion and vigour at work, which are considered important outcomes from the viewpoint of recovery (Sonnentag & Geurts, 2009), that is, indicating to what extent energy resources are available to the individual in the long term. These are also theoretically interesting outcomes, as they have been shown to be independent constructs and not only endpoints of the same energy construct (Demerouti, Moster, & Bakker, 2010; Mäkikangas, Feldt, Kinnunen, & Tolvanen, 2012). Besides these theoretical implications, the resulting knowledge may result in new practical implications for developing targeted occupational health interventions. For example, the results may help to specify whether interventions should be primarily targeted at certain types of work-related rumination or well-being or both of these.

Theory and Hypotheses Development

Work-Related Rumination

Martin and Tesser (1996, p. 7) conceptualized rumination as “a class of conscious thoughts that revolve around a common instrumental theme and that recur in the absence of immediate environmental demands requiring the thoughts”. Rumination also relates to unattained goals, as unexpected (slower or faster) progress towards a goal prompts rumination (Martin & Tesser, 1996, p. 4). Despite this fairly neutral definition, there is a tendency in the literature to conceptualize rumination as a negative process, and in fact most research focuses on repetitive thinking about negative experiences. However, rumination does not necessarily need to be a negative experience. Besides distinguishing positive and negative ruminative thoughts, Segerstrom, Stanton, Alden, and Shortridge (2003) argued that they should also be separated according to their purpose or focus (i.e.,

problem-solving vs. searching for meaning). Pravettoni, Cropley, Leotta and Bagnara (2007) differentiated between “repetitive” and “creative” rumination, and, more recently, Cropley and Zijlstra (2011) have differentiated between affective rumination and problem-solving pondering.

In the present study we defined work-related rumination in line with Cropley and Zijlstra (2011) who have included three concepts under work-related rumination (see also Querstret & Cropley, 2012; Zijlstra et al., 2014): affective work-related rumination, problem-solving pondering and lack of psychological detachment from work. *Affective rumination* is described as the experience of intrusive, pervasive and recurrent thoughts, in which attention is mainly directed to feelings related to work problems. This kind of thinking about work-related issues results in a negative emotional response (e.g., frustration, annoyance). In this affective state, psychophysiological arousal remains high, which is not conducive to the recovery process (Brosschot, Gerin, & Thayer, 2006). Particularly in the long run, affective rumination may result in cumulative effects on well-being by chronically depleting resources over time (Firoosabadi, Uitdewilligen, & Zijlstra, 2016; Sluiter, Frings-Dresen, van der Beek, & Meijman, 2001). It has also been shown that perseverative cognition (i.e., rumination about the past and worries about the future) affects cardiovascular, autonomic and endocrine nervous system activity, suggesting a pathogenic pathway to long-term disease outcomes (see Ottaviani et al., 2016, for a meta-analysis).

In contrast, *problem-solving pondering* is focused on finding solutions to work-related problems. Accordingly, problem-solving pondering is defined as unemotional, prolonged thinking about solutions to particular work-related problems (Cropley & Zijlstra, 2011). The consequences of problem-solving pondering may therefore be positive if it results in a solution. Even if the problem is not solved, pondering may lead to a specific plan for dealing with the task, which also promotes recovery as then the job task is no longer present in mind (Syrek, Weigelt, Peifer, & Antoni, 2017). Firoosabadi et al.

(2016) have therefore argued that problem-solving pondering may reduce cumulative effects on well-being by producing psychological resources over time.

Psychological detachment from work refers to the subjective experience of leaving work behind, to “switching off” and to forgetting work during non-work time (Sonnentag & Fritz, 2007). Thus it means not thinking about one’s job and also includes detaching from positive work events and thoughts, such as reflecting positively about one’s job during non-work time. Successful psychological detachment from work during off-job time has been shown to be a powerful recovery experience promoting recovery (see Sonnentag & Fritz, 2015; Sonnentag et al., 2017; Wendsche & Lohmann-Haislah, 2017, for reviews). However, evidence on its longitudinal effects on well-being is thus far scarce (see Sianoja, Kinnunen, Mäkikangas, & Tolvanen, 2018; Sonnentag, Binnewies, & Mojza, 2010, for exceptions).

From these definitions of the three concepts, we may conclude that affective rumination and pondering imply lack of detachment. Nevertheless, lack of detachment may refer to the appearance of any kind of work-related thoughts (repetitive or not, negative or positive, problem-focused or not). Earlier studies have shown that although these three types of work-related ruminative thoughts are separate concepts, they correlate with each other. According to Sonnentag and Fritz (2015), poor detachment relates to rumination (both affective rumination and problem-solving pondering) but is not an identical concept (correlations range between .40 and .50). Affective rumination and problem-solving pondering have shown correlations of a level similar to that of poor detachment (Firoozabadi et al., 2016; Hamesch, Cropley, & Lang, 2014; Querstret & Cropley, 2012). Thus these three concepts seem to capture different aspects of work-related rumination.

Absence of Exhaustion and Vigour as Resources

As discussed earlier, work-related rumination is expected to have effects on recovery, and, depending on the nature of the thoughts, the effects may be either negative or positive. In the present

study we examined both exhaustion and vigour as outcomes of work-related rumination during off-job time. On the basis of conservation of resources (COR) theory, we define them both as valued energy resources (Hobfoll, 2001). Internal resources, such as energy and positive mood, are the most important resources in the context of recovery from work (Sonnentag & Fritz, 2007).

We focused on job exhaustion, which is the core symptom of burnout (Maslach, Schaufeli, & Leiter, 2001), and vigour at work, which is the core component of work engagement (Shirom, 2010). Job exhaustion refers to feelings of strain, tiredness and fatigue due to prolonged involvement in an over-demanding work situation depleting an individual's overall energy (Maslach et al., 2001). Vigour refers to high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persevering in the face of difficulties (Schaufeli, Salanova, González-Romá, & Bakker, 2002). Both of these can be considered long-term outcomes, as job exhaustion, as part of the larger burnout concept, is seen as a chronic state which is not relieved by daily or weekly rest (Maslach et al., 2001) and vigour at work, as part of the larger concept of work engagement (Schaufeli et al., 2002), refers to persistent positive mood rather than a momentary state.

Hypotheses Development

We base our hypotheses regarding normal, reversed and reciprocal effects between work-related rumination and employee well-being on effort-recovery theory (Meijman & Mulder, 1998) and COR theory (Hobfoll, 2001). Effort-recovery theory emphasizes that resources invested in work are best replenished during off-job time by refraining from work demands. COR theory proposes that when an individual experiences stress resources are threatened or lost. For recovery to take place, new internal resources (e.g., energy) must be gained and threatened or lost resources must be restored (Sonnentag & Fritz, 2007). Both theories emphasize resource depletion and replenishment and, based on both

theories, energy can be considered the most relevant resource for recovery. From COR theory we utilize the concepts of resource loss (depletion) and gain (replenishment) and their cycles/spirals. These cycles suggest that individuals with more resources are better equipped for resource gains and that individuals with fewer resources are more likely to experience resource losses.

In our study we test the hypotheses over one and two years. As the appropriate time lag to examine long-term recovery processes is unknown, it is important to study several time points to detect potential lagged effects (Dormann & Griffin, 2015; Kelloway & Francis, 2013; Taris & Kompier, 2014). Based on the current knowledge, we have no theoretical reasons to expect that the effects would be different over one year or two years. These two time lags were chosen as there are earlier studies showing that one year may be an appropriate time lag to reveal the lagged effects (Firoozabadi et al., 2016; Sianoja et al., 2018; Sonnentag et al., 2010). In addition, one-year time lags appear to be most common and useful in longitudinal studies investigating the long-term job stressors-strain relationship (see Ford et al., 2014, for a review). Job stressors are closely related to work-related rumination (Kinnunen et al., 2017; Syrek et al., 2017). However, as not all studies using a one-year time lag have revealed lagged effects (e.g., Firoozabadi et al., 2016; Kinnunen & Feldt, 2013), we expanded the time lag to two years. As we were interested in long-term effects, we considered a longer time period more appropriate than a shorter one.

Normal lagged effects of affective rumination on well-being. Affective rumination after work leads to sustained activation because there are negative outcome expectancies for attaining work goals (Martin & Tesser, 1996). In addition, ruminating about the negative aspects of work is associated with increased negative affect, which also maintains prolonged activation and influences well-being negatively in the long run (Finch, Baranik, Liu, & West, 2012). As a result, individuals' resources are drained during recovery time; that is, exhaustion exacerbates and vigour diminishes. So far this resource loss has only been empirically examined in one longitudinal study: Firoozabadi et al. (2016)

showed that affective rumination was a significant predictor of increase in exhaustion over one year. In addition, in a cross-sectional study by Querstret and Cropley (2012) affective rumination was significantly associated with increased work-related fatigue. It has also been shown that those scoring high in affective rumination showed least work engagement, of which vigour is a part, over a two-year period (Kinnunen et al., 2017). Based on this evidence, we hypothesize:

H1a. Affective rumination is positively related to job exhaustion across one and two years.

H2a. Affective rumination is negatively related to vigour across one and two years.

Normal lagged effects of problem-solving pondering on well-being. Although problem-solving pondering during recovery time draws on an individual's cognitive resources, pondering about interesting work-related issues and finding solutions to them may serve as a recovery experience (Bennett, Gabriel, Calderwood, Dahling, & Trougakos, 2016) and cause positive affect (Seo, Barrett, & Bartunek, 2004). Especially in the long run, according to the broaden-and-build theory of positive emotions (Fredrickson, 1998), momentary experiences of positive emotions can trigger upward spirals toward well-being over time by building psychological resources (Fredrickson & Joiner, 2002). In the cross-sectional study by Querstret and Cropley (2012) problem-solving pondering was associated with reduced fatigue. In two other studies employees high in pondering exhibited the highest level of work engagement (Bennett et al., 2016; Kinnunen et al., 2017), of which vigour is a part (Schaufeli et al., 2002). In the latter study, high engagement among pondering employees was observed across two years. Based on these considerations, we hypothesize:

H3a. Problem-solving pondering is negatively related to job exhaustion across one and two years.

H4a. Problem-solving pondering is positively related to vigour across one and two years.

Normal lagged effects of lack of detachment from work on well-being. According to Sonnentag and Fritz (2015), detachment from work can stop acute load reactions (such as fatigue) from

accumulating and prevent an increase in chronic strain reactions over time. Without detachment the energy loss cycle continues as resources are not replenished during off-job time, suggesting an increase in exhaustion and a decrease in vigour in the long term. Two recent meta-analyses (Bennett et al., 2018; Wendsche & Lohmann-Haislah, 2017) and one review (Sonnentag & Fritz, 2015) showed that detachment is systematically associated with less exhaustion and more vigour and the relationship may be stronger with fatigue (including exhaustion) than vigour. To date two longitudinal studies have found that lack of psychological detachment from work predicted an increase in job exhaustion over the course of one year (Sianoja et al., 2018; Sonnentag et al., 2010). We propose the following hypotheses:

H5a. Lack of psychological detachment is positively related to job exhaustion across one and two years.

H6a. Lack of psychological detachment is negatively related to vigour across one and two years.

Reversed lagged effects of well-being on affective rumination. High exhaustion combined with low vigour means that resources to attain work goals are reduced. This may in turn trigger affective rumination in the long-term as the rate of progress toward goals is slower than expected (Martin & Tesser, 1996, p. 4). Conversely, when energy resources are high (high levels of vigour, in particular), work goals are more easily achieved and affective rumination is avoided. High exhaustion entails poorer cognitive functioning, such as memory and attention deficits, assessed by self-ratings, peer-ratings and neuropsychological testing (Feuerhahn, Stamov-Roßnagel, Wolfram, Bellingrath, & Kudielka, 2013) due to the preoccupation of the mind with worrying thoughts. Poorer cognitive functioning due to poor well-being may also be an important factor explaining the link between well-being and job performance (Vuori et al., 2014). Performance deficits may increase over time because exhausted employees will be less and less able to invest extra effort in order to compensate for these deficits. As a result, exhausted employees may increasingly ruminate about their work or try to

complete work-related tasks outside working hours. As far as we know, no longitudinal empirical evidence on these reversed relationships has so far been presented. Based on theoretical considerations, we hypothesize:

H1b. Job exhaustion is positively related to affective rumination across one and two years.

H2b. Vigour is negatively related to affective rumination across one and two years.

Reversed lagged effects of well-being on problem-solving pondering. We also expect that high levels of exhaustion may lead to a decrease in problem-solving pondering and high levels of vigour may lead to an increase in problem-solving pondering across time. Exhaustion implies fewer energy resources to achieve work goals, and therefore less goal-directing problem-solving pondering, whereas vigorous employees may be energized to engage in problem-solving pondering during their free time. Employees with burnout also often report reduced problem-solving and learning abilities (Maslach et al., 2001; Schaufeli & Enzmann, 1998). In addition, exhausted employees may have difficulties in focusing their thoughts on work goals due to deficits in self-control, for example, in attention direction (Van Der Linden, Keijsers, Eling, & van Schaijk, 2005), which decreases problem-solving pondering in the long-term. Vigour – as well as work engagement – is maintained through the achievement of work goals (Leiter & Bakker, 2010), which further supports the positive link between vigour and pondering in the long term. However, there is as yet no longitudinal evidence on potential reversed lagged effects. Based again on theoretical considerations, we hypothesize:

H3b. Job exhaustion is negatively related to problem-solving pondering across one and two years.

H4b. Vigour is positively related to problem-solving pondering across one and two years.

Reversed lagged effects of well-being on lack of detachment from work. Sonnentag and Fritz (2015) argue that employees higher in burnout may have a harder time detaching from work. The reason for that may relate to reduced self-regulative capacity that would be needed to refrain from

thinking about work-related matters when it is not necessary (Muraven & Baumeister, 2000). The study by Sonnentag, Arbeus, Mahn and Fritz (2014) found that exhaustion predicts a decrease in psychological detachment from work over the course of four weeks. This decrease was particularly marked among employees working under time pressure and those who did not engage in pleasurable leisure experiences. Thus these findings suggest that exhausted employees find detachment from work increasingly difficult to achieve and may therefore suffer from insufficient recovery – although they are the ones who need it most. For example, initially exhausted employees may try to counteract their exhaustion by investing extra effort, which in turn further depletes their energy resources and exacerbates the negative consequences in the long-term. Conversely, vigorous employees have enough energy and therefore self-control to detach from work and maintain their vigour in the long term. We propose the following hypotheses:

H5b. Job exhaustion is positively related to lack of psychological detachment across one and two years.

H6b. Vigour is negatively related to lack of psychological detachment across one and two years.

Reciprocal lagged effects between rumination and well-being. Based on COR theory (Hobfoll, 2001), we also speculate that both types of lagged effects (normal and reversed) are simultaneously valid. In line with the principle of resource loss and gain cycles, affective rumination may trigger an energy depletion process (i.e., increase exhaustion and reduce vigour), which may, in turn, increase rumination. Problem-solving pondering may serve as a recovery experience promoting recovery (Bennett et al., 2016), that is, reduce exhaustion and increase vigour, and therefore also fuel further problem-solving pondering. Lack of detachment from work does not help to replenish energy resources (i.e., reduce exhaustion and increase vigour), which makes it more difficult to further detach from work (Sonnentag & Fritz, 2015). As far as we know, these reciprocal effects have not been examined. Based on theoretical considerations, we hypothesize:

H1c. Affective rumination is positively related to job exhaustion and simultaneously job exhaustion is positively related to affective rumination across one and two years.

H2c. Affective rumination is negatively related to vigour and simultaneously vigour is negatively related to affective rumination across one and two years.

H3c. Problem-solving pondering is negatively related to job exhaustion and simultaneously job exhaustion is negatively related to problem-solving pondering across one and two years.

H4c. Problem-solving pondering is positively related to vigour and simultaneously vigour is positively related to problem-solving pondering across one and two years.

H5c. Lack of detachment is positively related to job exhaustion and simultaneously job exhaustion is positively related to lack of detachment across one and two years.

H6c. Lack of detachment is negatively related to vigour and simultaneously vigour is negatively related to lack of detachment across one and two years.

Method

Participants and Procedure

The participants came from 11 Finnish organizations in different sectors (e.g., education, information technology and media). By sampling different organizations, we wanted to include employees from a variety of different jobs. Participants were informed about the study goals and assured that their responses would be treated confidentially and that participation was voluntary.

The questionnaire data were collected in three waves using electronic questionnaires (see Kinnunen et al., 2017). First, in spring 2013 (Time 1), of the employees contacted ($N = 3,593$), 1,347 returned the completed questionnaire after two reminders, yielding a response rate of 36%. Second, in spring 2014 (Time 2) those employees who responded in 2013 and who were still employed by the

same organizations ($N = 1,192$) were contacted. Of these, 841 employees returned the completed questionnaire, yielding a response rate of 71%. Third, in spring 2015 (Time 3) those who responded in 2013 and 2014, and who were still employed by the same organizations ($N = 799$) were contacted. Of these, 664 employees responded, yielding a response rate of 83%. Thus the three-wave questionnaire data included 664 participants.

At Time 1 of this long-term sample ($N = 664$), 58% were women. The participants' average age was 47.5 years (range 23–66, $SD = 9.9$). Of the sample, 38% held an academic degree (master's level or higher), 26% had a polytechnic degree, and the rest (36%) had a vocational school qualification or less. The majority had a permanent job (91%), worked full-time (97%) and worked a regular day shift (90%). Average hours worked weekly were 39 ($SD = 5.9$). Of the participants, 54.5% worked in the public sector, and the rest (45.5%) worked in the private sector (see anonymous, for a more detailed description).

Sample Attrition

In analysing sample attrition, we compared the characteristics of the participants of the long-term sample with the dropouts (non-respondents either at T2 or at T3). The results indicated that the participants more often had a permanent employment contract (91% vs. 80%, $p < .001$), worked more often on a regular day shift (90% vs. 85%, $p < .05$) and were older (47.5 vs. 46.2 years, $p < .05$) than the dropouts. The attrition analysis for the main study variables showed that the dropouts engaged more often in affective rumination (2.58 vs. 2.43, $p < .01$), and reported higher levels of exhaustion (2.06 vs. 1.86, $p < .05$) and lower levels of vigour (4.42 vs. 4.58, $p < .05$) than participants in the longitudinal sample.

Measures

This study was part of a larger project on recovery from work stress. Therefore the measures for each construct had to be short. We chose items known from earlier studies to have the highest loadings

on each construct. All main constructs were measured three times (T1–T3).

Work-related rumination was measured as follows: *Affective rumination* (“I become tense when I think about work-related issues in my free time”, “I am irritated by work issues when not at work”, “I am annoyed by thinking about work-related issues when not at work”) and *problem-solving pondering* (“I find solutions to work-related problems in my free time”, “I find that thinking about work during my free time helps me to be creative”, “I think about tasks that need to be done at work the next day”) were each assessed with three items from the Work-Related Rumination Questionnaire (Cropley, Michalianou, Pravettoni, & Millward, 2012). The response scale ranged from 1 (very seldom or never) to 5 (very often or always). *Psychological detachment from work* was measured using three items from the Recovery Experience Questionnaire (Sonnentag & Fritz, 2007), which has been validated in Finland (Kinnunen et al., 2011). Participants were asked to respond to the items with respect to their off-job time (“I forget about work”, “I don’t think about work at all”, “I distance myself from my work”) using a scale ranging from 1 (totally disagree) to 5 (totally agree). These rumination concepts have been shown to be separate in factor analyses (Vahle-Hinz, Mauno, De Bloom, & Kinnunen, 2017; Querstret & Cropley, 2012) (see also Table 1, for correlations).

Job exhaustion was measured with the job exhaustion scale (5 items, e.g., “I feel emotionally drained from my work”) from the Maslach Burnout Inventory – General Survey (Maslach, Jackson, & Leiter, 1996), which has been validated in Finland (Kalimo, Hakanen, & Toppinen-Tanner, 2006). *Vigour at work* was measured by the shortened 3-item scale of vigour (e.g., “At my work, I feel bursting with energy”) from the Utrecht Work Engagement Scale (Schaufeli, Bakker, & Salanova, 2006), of which the construct validity has been found to be good in Finnish occupational samples (Seppälä et al., 2009). The response scale ranged from 0 (never) to 6 (every day) for both measures.

Regarding *control variables*, we focused on one job demand, that is, time pressure (too much work) at T1, because it reportedly most often plays a role in work-related rumination (Berset, Elfering,

Luthy, Luthi, & Semmer, 2011; Syrek & Antoni, 2014; Syrek et al., 2017). *Time pressure* was measured with three items (“How often does your job require you to work very fast?”, “How often does your job leave you with little time to get things done?”, “How often does your job require you to work under time pressure?”) from the Quantitative Workload Inventory (Spector & Jex, 1998). The items were rated on a scale from 1 (very seldom or never) to 5 (very often or always).

Statistical Analyses

The hypotheses of the present study were tested within the structural equation modelling (SEM) framework using the Mplus 8 programme (Muthen & Muthen, 1998–2012). Robust maximum likelihood (MLR) was used as the method of estimation as not all variables followed a normal distribution. Missing values were processed with the general missing type procedure (i.e., models were estimated utilizing all the data available without imputing) available in the Mplus program. Latent variables constructed by multiple observed items were chosen as they offer potential advantages enabling measurement errors to be taken into account.

We analysed the cross-lagged effects separately based on three (T1–T2–T3) and two measurement points (T1–T3) for each rumination construct and outcome. The first analysis covers the one-year cross-lagged effects and the second analysis the two-year effects. The analytical procedure included three major phases. In the *first* phase, a freely estimated stability model (M0) and a stability model with invariant factor loadings across time (M1) based on the latent constructs were tested. In these models, all autocovariances between the same observed variables (i.e., items) across time were allowed to correlate. The latter model (M1) was then compared with the former model (M0) using the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 2001) in order to establish the structural invariance of the latent variables across time. If chi-square difference test provides a non-significant loss-of-fit for M1 compared to M0, then M1 is supported. Demonstration of the structural invariance of the latent variables across time allows the further investigation of the longitudinal effects

(i.e., cross-lagged associations between the constructs) as then the observed effects are not due to structural change in the latent constructs over time.

In the *second* phase, the three different (normal, reversed, and reciprocal) effect models were tested, that is, the relationships included in each model, were added separately into the stability model described above. In the normal effect models (M2) each work-related rumination construct predicted either exhaustion or vigour at the later measurement point. In the reversed effect models (M3) the relationships were the opposite: well-being variables predicted each work-related rumination construct. The reciprocal models (M4) included the relationships in both the normal and the reversed effect models. After that, the three effect models were compared to the stability model using the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 2001). When an effect model yields a significant improvement in the model fit compared to the stability model, the effect model is supported. If several effect models showed an improvement, they were then compared with each other using the same procedure. In the *third* phase, the models showing significant cross-lagged effects were adjusted for time pressure at T1 as an observed mean scale.

Results

Descriptive Results

Means, standard deviations, Cronbach's alphas and correlations between the study variables are presented in Table 1. Mean level changes between T1 and T3 were found for problem-solving pondering ($p = .001$) and vigour ($p < .001$). The level of vigour was higher at T1 than at T2 and T3, and pondering was at a higher level at T3 than at T1 and T2. There were significant correlations in both directions, for example, between affective rumination at T1 and job exhaustion at T2 and, conversely, between job exhaustion at T1 and affective rumination at T2 ($r = .48$ and $.45$ respectively). All the variables also showed moderate rank-order stability over time ($r = .56-.72$).

Testing the Hypotheses

Table 2 reports the SEM models tested for *job exhaustion*, that is, hypotheses 1, 3 and 5 were tested. As can be seen, the structure of the stability models including latent study constructs (affective rumination, problem-solving pondering, detachment and exhaustion) turned out to be invariant across time based on the models with three (T1–T2–T3) and two measurement points (T1–T3). That is, the loss of fit of the constrained models (M1, factor loadings set to be invariant across time) was non-significant compared to the freely estimated stability models (M0, factor loadings allowed to vary across time). Thus the stability models with significant and time-invariant factor loadings and a good data fit (all fit indices acceptable) served as our baseline models to which cross-lagged models were statistically compared.

The results in Table 2 indicate that H1a, in which affective rumination was expected to predict later exhaustion, received support. For the various cross-lagged relationships across T1–T2–T3 the normal effect model (M2) showed a better fit with the data than the baseline stability model (M1) and so did the reversed (M3) and reciprocal model (M4). The comparison of the two best fitting models showed that the reciprocal model (M4) did not show improvement in model fit compared to the normal effect model (M2). Thus the normal effect model was the best fitting model. After controlling for time pressure at T1 by allowing it to predict both affective rumination and exhaustion at T1 the cross-lagged effects of the normal effect model remained significant and the model fitted the data well: $\chi^2(261) = 902.33, p < .001$, RMSEA = 0.06, SRMR = 0.04, TLI = 0.94, CFI = 0.95. As seen in Figure 1a, in which time pressure was controlled for in the model, both latent constructs, particularly affective rumination, showed relatively high stability over time. High affective rumination at T1 was found to predict high job exhaustion one year later at T2 and the same predictive association was also found between T2 and T3. Thus H1a received support across one year, but not across two years. This simultaneously implies that H1b expecting the reversed link from exhaustion to later affective rumination and H1c expecting the reciprocal links did not gain support.

The models testing the various relationships between problem-solving pondering and exhaustion (H3a, H3b and H3c) revealed that H3b, in which exhaustion was expected to predict later lower pondering, received support. For the different cross-lagged relationships across T1–T3 both the reversed (M3) and reciprocal (M4) models improved the model fit compared to the stability model (M1) (see Table 2). When these two models were compared it turned out that the reciprocal model (M4) did not improve the model fit compared to the reversed model (M3). Finally, the reversed model was adjusted for time pressure at T1 ($\chi^2(111) = 505.46, p < .001$, RMSEA = 0.07, SRMR = 0.08, TLI = 0.93, CFI = 0.94) and the results indicated that the reversed cross-lagged effect remained significant. In this final model, shown in Figure 1b, high exhaustion at T1 predicted low problem-solving pondering two years later at T3, thereby lending support to H3b across two years, but not across one year.

None of the different cross-lagged models concerning the relationships between lack of detachment and exhaustion improved the model fit compared with the stability model (see Table 2). Thus hypotheses H5a expecting normal, H5b expecting reversed and H5c expecting reciprocal relationships did not gain support.

Table 3 reports the SEM models tested for *vigour at work*, that is, hypotheses 2, 4 and 6 were tested. Again, we can see that, with one exception, the stability models with time-invariant factor loadings (M1) fitted better with the data than the freely estimated stability models (M0). This exception concerned the model consisting of detachment and vigour across T1–T3: the invariant stability model slightly weakened the model fit as compared to the freely estimated model (at the level of $p < .05$).

The results in Table 3 indicate that of the different cross-lagged models concerning the relationship between affective rumination and vigour (H2a, H2b and H2c), H2b, in which vigour was expected to predict later low affective rumination, received support. For the various cross-lagged relationships across T1–T2–T3, both reversed (M3) and reciprocal (M4) models improved the model fit compared to the baseline stability model (M1). When these two best models were compared, the

reciprocal model (M4) did not show improvement compared to the reversed model (M3). Therefore the reversed model was the best model. The reversed model was adjusted for time pressure at T1 ($\chi^2(138) = 444.15, p < .001$, RMSEA = 0.06, SRMR = 0.07, TLI = 0.95, CFI = 0.96), which did not change the significance of the cross-lagged effects. In this final model, shown in Figure 2a, high vigour at work at T1 was found to predict low affective rumination one year later at T2. However, the same predictive association did not reach the significance level between T2 and T3 ($\beta = -.06, p = .08$). Across T1–T3, these same models outperformed the stability model. Again, the reversed model (M3) turned out to be the best model, which did not change after adjusting for time pressure at T1 ($\chi^2(57) = 145.79, p < .001$, RMSEA = 0.05, SRMR = 0.05, TLI = 0.97, CFI = 0.98). As shown in Figure 2b, high vigour at T1 predicted low affective rumination also two years later at T3. Thus H2b received support across one year and two years and correspondingly H2a, expecting normal and H2c expecting reciprocal relationships, did not gain support.

None of the different cross-lagged models concerning the relationship between pondering and vigour (H4a, H4b and H4c) and between lack of detachment and vigour (H6a, H6b, H6c) improved the model fit compared with the stability model (see Table 3). Thus none of these hypotheses expecting normal (H4a, H6a), reversed (H4b, H6b) or reciprocal (H4c, H6c) relationships between these constructs were supported. The results of the hypotheses testing are summarized in Table 1 in Appendix.

Discussion

Our aim was to test the different cross-lagged relationships – normal, reversed and reciprocal – between various types of work-related ruminative thoughts and two well-being outcomes indicating resource depletion and replenishment (i.e., exhaustion and vigour). Thus we wanted to take a step forward in recovery and rumination research in establishing the temporal order between rumination and well-being across one and two years. Of the various interpretations of the relationships, reversed effects

gained most support, indicating that level of energy was important in determining type of ruminative thoughts.

Theoretical Contributions

Our study advanced the theoretical understanding of the lagged relationships between different work-related ruminative thoughts and well-being outcomes in the long term. *First*, our study contributes to a better understanding of the relationships by showing that the effects may run in both directions, and not only from rumination to well-being, as is often theoretically expected. This implies that the theories of recovery may be too simple or at least recovery processes have been studied too narrowly.

The reversed relationship from high vigour to low affective rumination especially gained longitudinal support across one, T1–T2, and two years, T1–T3. Between T2 and T3 the effect was marginally significant. This result obtained may be interpreted to support the view of rumination as a work-goal related concept (Martin & Tesser, 1996, p. 4): when energy resources are high in terms of high levels of vigour, progress toward goals is expected and the goals are likely met. Consequently, affective rumination is avoided in the long term. Those who are full of energy are also better in control to reduce ruminative thinking and this way disconnect from work (Sonnentag et al., 2014). The evidence is quite convincing as the long-term effects are found in both time lags.

Also, exhaustion played a role in predicting less problem-solving pondering across two years. This resource loss also supports the view that rumination relates to progress in attaining work goals. Exhaustion means less energy resources to achieve work goals, and therefore less goal-directed problem-solving pondering. Engaging in problem-solving pondering requires energy. The result is also in line with the findings reporting reduced problem-solving and learning abilities among employees with burnout symptoms (Maslach et al., 2001; Schaufeli & Enzmann, 1998). This suggests that exhausted employees may not have enough mental energy to engage in problem-solving pondering

during off-job time to attain their work goals. Our result moreover lends support to the findings showing that exhausted employees have difficulties in focusing their thoughts on the work goals due to self-control deficits in attention direction (Feuerhahn et al., 2013; Van Der Linden et al., 2005). It is probable that over time exhausted employees will become less and less able to invest extra effort in order to compensate for their deficits, which gradually results in a decrease in pondering. The normal effect concerning the link from problem-solving pondering to exhaustion was not supported, which is consistent with the findings of the study by Firoozabadi et al. (2016).

The resource loss from affective rumination to later exhaustion was the only relationship following normal effect model. Thus it seems that affective rumination after work leads to sustained activation (Ottaviani et al., 2016), for example, due to negative outcome expectancies regarding attaining work goals (Martin & Tesser, 1996) and negative affect (Cropley & Zijlstra, 2011), both of which influence well-being negatively in the long run. As a result, individuals' energy resources are drained during recovery time, limiting recovery during off-job time (Sonnentag et al., 2010). Our finding was similar as in the study by Firoozabadi et al. (2016) in which affective rumination was a significant predictor of increase in exhaustion over one year.

The *second* contribution of our study relates to the time lags used. By employing two time lags in our study we could demonstrate that the timeframes matter in examining long-term recovery processes. In particular, high exhaustion had a lagged effect on problem-solving pondering only across two years. This suggests that exhausted employees cannot invest compensatory effort in their work over long periods of time, which culminates in a decrease in problem-solving pondering during off-job time. A one-year time lag was crucial in the normal lagged effect from affective rumination to exhaustion, but in this case a two-year perspective was also meaningful as the lagged effect was seen through T1-T2-T3. Although our results provided some support for the use of both time lags, most often the lagged

effects were not detected. This suggests that shorter time lags (e.g., 3–6 months) could be more optimal to show the expected cross-lagged effects (Dormann & Griffin, 2015).

Third, defining work-related rumination broadly, we could show that only affective rumination, but neither pondering nor lack of detachment, was detrimental to well-being (increasing exhaustion) in the long term. Most strikingly, the findings did not support the role of psychological detachment in the context of employee well-being. Its important role as a recovery experience has been shown especially in cross-sectional and diary studies (Bennett et al., 2018; Sonnentag & Fritz, 2015; Wendsche & Lohmann-Haislah, 2017) and in two longitudinal studies in which poor detachment predicted exhaustion over one year (Sianoja et al., 2018; Sonnentag et al., 2010). Still in another study high exhaustion predicted poor detachment four weeks later (Sonnentag et al., 2014) but not vice versa. Nevertheless, there is also one study in which neither normal nor reversed relationships were found across one year (Kinnunen & Feldt, 2013). Thus the longitudinal evidence is still inconclusive.

The null findings regarding detachment may relate to the fact that detachment from work includes not only detaching from negative but also from positive work-related thoughts. Therefore, the positive well-being effects found in relation to positive work reflection during off-job time (e.g., Sonnentag & Grant, 2012) may counteract the negative effects, and result in null findings. The different types of analyses (regression analysis, latent change score models, cross-lagged analysis) employed in these earlier studies may also play a role. From a more theoretical perspective, it may be that the positive effects of psychological detachment are best realized after experiencing high stress, that is, when there is a need to recover (Sonnentag et al., 2017). In our study we were not able to take stress levels into account. Nevertheless, the inconsistent longitudinal results suggest that further studies are needed using different time lags. We recommend shorter time lags on the basis of what Dormann and Griffin (2015) recommended concerning optimal time lags in panel studies of psychological processes.

Another relationship which was not supported in either direction was that between problem-solving pondering and vigour. Problem-solving pondering did not increase vigour, nor did vigour increase problem-solving pondering. Earlier studies have suggested that pondering may be a recovery experience promoting work engagement (Bennett et al., 2016; Kinnunen et al., 2017). However, it seems that its effects are also counterproductive. When looking in more detail at the study results by Bennett and colleagues (2016), we learn that, despite high work engagement, pondering employees also had a higher exhaustion level compared to other recovery experience profiles. Therefore pondering also depletes resources to some extent, and not only replenish them. In our study pondering had slightly positive correlations with both vigour and exhaustion. It may also be that a shorter time lag would have been needed to detect lagged effects. In sum, future research is needed to investigate the circumstances under which problem-solving pondering and detachment facilitate (or pondering conversely impedes) the recovery process during nonwork time.

Fourth, our study also contributes to the study of employee well-being, suggesting different relationships between vigour and exhaustion. Vigour was crucial to less affective rumination, whereas exhaustion was crucial to less problem-solving pondering. These differential results support the view that vigour and exhaustion reflect independent constructs (and not mere opposite sides of the same coin), and that both should be examined (Demerouti et al., 2010; Mäkikangas et al., 2012).

Practical Implications

Based on our results, occupational health interventions intended to decrease affective work-related rumination are recommended. In this regard cognitive behaviour therapy (Querstret & Cropley, 2013; Querstret, Cropley, Kruger, & Heron, 2015) and mindfulness-based interventions (Querstret, Cropley, & Fife-Schaw, 2017) for changing ways of thinking and focusing on the present have shown to be effective. An efficient low-cost intervention to prevent rumination is instructing employees to set daily goals and to create an action plan at the end of the day for (a) where, (b) when and (c) how they

will accomplish unachieved goals (Smit, 2016). This intervention is based on the fact that unexpectedly slow progress in goal attainment can trigger rumination (Martin & Tesser, 1996; Syrek & Antoni, 2014).

In addition, our results suggest that decreasing exhaustion and increasing vigour at work are advisable. In this regard job crafting – proactive behaviours that employees engage in to increase challenge and to decrease hindrance job demands, as well as to increase structural and social job resources (Tims, Bakker, & Derks, 2012) – may be productive (see Rudolph, Katz, Lavigne, & Zacher, 2017, for a meta-analysis). Decreasing job demands, in particular, may decrease exhaustion and increasing job resources may increase vigour.

Limitations and Future Directions

There are several limitations to be taken into account. First, the response rates were relatively low (i.e., 37.5% at T1, 23.4% at T2 and 18.5% at T3 relative to baseline respondents) which raises the possibility that response bias may affect the generalizability of our results. However, the response rate at baseline was not lower than those typical of studies conducted in organizations (see Baruch & Holtom, 2008, for a review). The dropout analyses revealed that dropout was related to background factors (temporary employment contract, other than day shift and older age). Attrition was also connected to the study variables (affective rumination, exhaustion and vigour). Therefore our results may be biased owing to minor self-selection, which is typical of longitudinal studies. Attrition may also relate to the fact that we were able to follow-up only those employees who did not transfer to another organization. In the future it would be important to be able also to follow-up job-changers and thereby to avoid dropouts. Nevertheless, we found significant effects and had a diverse and large sample, which adds to the generalizability of our results.

Second, our study was based on self-report measures and may be susceptible to common method bias. However, our longitudinal study design and the use of established scales with good psychometric

properties may have reduced the degree of common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Nonetheless, future studies could reduce common method variance by applying significant others' reports of a person's level of rumination during off-job time. Third, we used shortened scales in order to limit the length of the questionnaire because this study was part of a larger research project. Although this may jeopardize the construct validity of the scales, we are confident that it hardly affects our measures, which were shown to be time-invariant with high item loadings and high internal reliability, except for problem-solving pondering, of which reliability remained slightly below .70. This may suggest that there was too much variety in the content of the items (e.g., problem-solving and creativity were included) and therefore the short measure functioned as an index rather than as a scale, implying that internal consistency may not be a good criterion for this measure (Streiner, 2003).

Fourth, the differences between the three work-related rumination concepts deserve more attention in the future. For example, as psychological detachment from work implies a state during which the individual is capable of dispelling all thoughts of work – including positive work reflection – its position needs further clarification. It could be good to ascertain more directly which kind of work-related thoughts (negative vs. positive) employees detach themselves from. This differentiation could help to further clarify the relationship between lack of detachment, affective rumination and problem-solving pondering.

Conclusions

To conclude, the present study showed that the lagged effects between work-related rumination and well-being may run in both directions and that the time lag between measurements matters. Reversed effects gained most support, indicating that level of energy was important in determining type of ruminative thoughts. The reversed relationship from high vigour to low affective rumination was supported both across one and two years and high exhaustion had a lagged effect on low problem-

solving pondering across two years. The lagged effect from high affective rumination to high exhaustion across one year was the only relationship following normal effect model.

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Table 1

Correlations of the Study Variables (n = 645–664)

<i>Variables</i>	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Time pressure T1	3.87	0.82	.88															
2. Affective rumination T1	2.43	0.88	.27	.87														
3. Pondering T1	2.88	0.77	.21	.19	.68													
4. Detachment at T1	2.98	0.97	-.21	-.33	-.55	.86												
5. Job exhaustion at T1	1.86	1.43	.38	.57	.17	-.29	.93											
6. Vigour T1	4.58	1.19	.00	-.39	.07	.12	-.47	.89										
7. Affective rumination T2	2.43	0.89	.26	.66	.14	-.28	.45	-.34	.89									
8. Pondering T2	2.88	0.74	.10	.14	.69	-.44	.10	.10	.13	.68								
9. Detachment T2	3.03	0.97	-.18	-.27	-.45	.62	-.20	.09	-.31	-.49	.86							
10. Job exhaustion T2	1.90	1.42	.33	.48	.10	-.24	.69	-.35	.57	.05	-.25	.93						
11. Vigour T2	4.44	1.30	.05	-.31	.05	.12	-.34	.68	-.41	.13	.14	-.45	.91					
12. Affective rumination T3	2.46	0.89	.15	.56	.06	-.19	.39	-.32	.70	.03	-.21	.48	-.36	.89				
13. Pondering T3	2.95	0.76	.18	.09	.70	-.46	.06	.13	.11	.72	-.48	.05	.11	.07	.70			
14. Detachment T3	3.01	0.95	-.12	-.20	-.43	.59	-.17	.08	-.26	-.42	.65	-.19	.12	-.29	-.51	.85		
15. Job exhaustion T3	1.92	1.44	.26	.36	.11	-.19	.58	.31	.48	.07	-.21	.70	.37	.57	.08	-.28	.93	
16. Vigour T3	4.44	1.32	.06	-.24	.05	.11	-.28	.64	-.34	.10	.12	-.37	.71	-.42	.13	.17	-.49	.91

Note. If $r \geq |.13|$, $p < .001$. Cronbach's alphas are shown on the diagonal.

Table 2

Goodness of Fit Statistics for the Tested Cross-lagged SEM-models between Work-Related Rumination and Job Exhaustion (T1–T2–T3, T1–T3)

Model fit						Model comparison	
T1–T2–T3	χ^2 (df)	RMSEA	SRMR	TLI	CFI	Model	$\Delta \chi^2$ (df)
Affective rumination							
M0	828.77 (229)	0.06	0.06	0.94	0.95		
M1	851.14 (241)	0.06	0.07	0.94	0.95	M1 vs. M0	14.90 (6)
M2	834.36 (239)	0.06	0.04	0.94	0.95	M2 vs. M1	15.87 (2)***
M3	844.34 (239)	0.06	0.05	0.94	0.95	M3 vs. M1	6.80 (2)*
M4	831.72 (237)	0.06	0.04	0.94	0.95	M4 vs. M1	19.16 (4)***
						M4 vs. M2	2.64 (2)
Pondering							
M0	1140.27 (229)	0.08	0.10	0.91	0.90		
M1	1157.54 (241)	0.08	0.10	0.90	0.91	M1 vs. M0	3.76 (12)
M2	1156.37 (239)	0.08	0.10	0.90	0.91	M2 vs. M1	1.99 (2)
M3	1153.06 (239)	0.08	0.10	0.90	0.91	M3 vs. M1	4.48 (2)
M4	1151.96 (237)	0.08	0.10	0.90	0.91	M4 vs. M1	6.28 (4)
Detachment							
M0	791.76 (229)	0.06	0.04	0.94	0.95		
M1	809.26 (241)	0.06	0.04	0.94	0.95	M1 vs. M0	8.32 (12)
M2	807.07 (239)	0.06	0.04	0.94	0.95	M2 vs. M1	2.19 (2)
M3	809.92 (239)	0.06	0.04	0.94	0.95	M3 vs. M1	0.67 (2)
M4	807.75 (237)	0.06	0.04	0.94	0.95	M4 vs. M1	2.13 (4)
T1–T3							
Affective rumination							
M0	363.72 (92)	0.07	0.04	0.95	0.96		
M1	375.56 (98)	0.07	0.04	0.95	0.96	M1 vs. M0	8.94 (6)
M2	374.44 (97)	0.07	0.04	0.95	0.96	M2 vs. M1	8.72 (1)
M3	373.28 (97)	0.07	0.03	0.95	0.96	M3 vs. M1	2.14 (1)
M4	373.14 (96)	0.07	0.03	0.96	0.95	M4 vs. M1	2.20 (1)
Pondering							

M0	461.648 (92)	0.08	0.09	0.92	0.94		
M1	466.466 (98)	0.08	0.09	0.93	0.94	M1 vs. M0	0.76 (6)
M2	466.528 (97)	0.08	0.09	0.93	0.94	M2 vs. M1	0.22 (1)
M3	460.218 (97)	0.08	0.09	0.93	0.94	M3 vs. M1	6.22 (1)**
M4	460.288 (96)	0.08	0.09	0.93	0.94	M4 vs. M1	6.29 (2)*
						M4 vs. M3	0.17 (1)
Detachment							
M0	333.92 (92)	0.06	0.03	0.95	0.96		
M1	345.50 (98)	0.06	0.03	0.95	0.96	M1 vs. M0	9.54 (6)
M2	345.52 (97)	0.06	0.03	0.95	0.96	M2 vs. M1	0.26 (1)
M3	345.26 (97)	0.06	0.03	0.95	0.96	M3 vs. M1	0.24 (1)
M4	345.26 (96)	0.06	0.03	0.95	0.96	M4 vs. M1	0.52 (2)

Notes. M0 = free stability model, M1 = constrained stability model, M2 = normal effect model, M3 = reversed effect model, M 4 = reciprocal effect model. RMSEA = root mean square of approximation, SRMR = standardized root mean square residual [values ≤ 0.08 indicate a good data fit]; TLI = Tucker Lewis Index, CFI = Comparative Fit Index [values close to 0.95 indicate a good fit of the model (Hu & Bentler, 1999)]. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3

Goodness of Fit Statistics for the Tested Cross-lagged SEM-models between Work-Related Rumination and Vigour at Work (T1–T2–T3, T1–T3)

Model fit						Model comparison	
T1–T2–T3	χ^2 (df)	RMSEA	SRMR	TLI	CFI	Model	$\Delta \chi^2$ (df)
Affective rumination							
M0	404.85 (116)	0.06	0.08	0.95	0.96		
M1	417.75 (124)	0.06	0.08	0.96	0.96	M1 vs. M0	12.11 (8)
M2	413.98 (122)	0.06	0.08	0.96	0.96	M2 vs. M1	3.92 (2)
M3	409.96 (122)	0.06	0.07	0.96	0.96	M3 vs. M1	7.79 (2)*
M4	407.18 (120)	0.06	0.07	0.95	0.96	M4 vs. M1	10.57 (4)*
						M4 vs. M3	2.78 (2)
Pondering							
M0	571.30 (116)	0.08	0.08	0.91	0.94		
M1	579.25 (124)	0.07	0.08	0.92	0.94	M1 vs. M0	4.83 (8)
M2	578.70 (122)	0.08	0.08	0.92	0.94	M2 vs. M1	0.04 (2)
M3	576.51 (122)	0.08	0.08	0.92	0.94	M3 vs. M1	0.88 (2)
M4	575.10 (120)	0.08	0.08	0.92	0.94	M4 vs. M1	1.84 (4)
Detachment							
M0	373.09 (116)	0.06	0.06	0.96	0.97		
M1	384.69 (124)	0.06	0.06	0.96	0.97	M1 vs. M0	10.14 (8)
M2	383.65 (122)	0.06	0.06	0.96	0.97	M2 vs. M1	1.57 (2)
M3	384.43 (122)	0.06	0.06	0.96	0.97	M3 vs. M1	0.26 (2)
M4	383.46 (120)	0.06	0.06	0.96	0.97	M4 vs. M1	2.12 (4)
T1–T3							
Affective rumination							
M0	127.13 (44)	0.05	0.06	0.97	0.98		
M1	134.97 (48)	0.05	0.06	0.97	0.98	M1 vs. M0	7.80 (4)
M2	134.48 (47)	0.05	0.06	0.97	0.98	M2 vs. M1	0.03 (1)
M3	128.98 (47)	0.05	0.05	0.97	0.98	M3 vs. M1	6.27 (1)**
M4	128.98 (47)	0.05	0.05	0.97	0.98	M4 vs. M1	6.88 (2)*
						M4 vs. M3	0.35 (1)
Pondering							

M0	104.50 (44)	0.05	0.06	0.98	0.99		
M1	106.66 (48)	0.04	0.06	0.98	0.99	M1 vs. M0	2.44 (4)
M2	106.60 (47)	0.04	0.06	0.98	0.99	M2 vs. M1	0.15 (1)
M3	104.44 (47)	0.04	0.06	0.98	0.99	M3 vs. M1	2.22 (1)
M4	104.35 (46)	0.04	0.06	0.98	0.99	M4 vs. M1	2.22 (2)
Detachment							
M0	59.46 (44)	0.02	0.03	0.99	0.99		
M1	70.09 (48)	0.03	0.03	0.99	0.99	M1 vs. M0	10.57 (4)*
M2	69.60 (47)	0.03	0.03	0.99	0.99	M2 vs. M1	0.53 (1)
M3	69.91 (47)	0.03	0.03	0.99	0.99	M3 vs. M1	0.18 (1)
M4	69.40 (46)	0.03	0.03	0.99	0.99	M4 vs. M1	0.69 (2)

Notes. M0 = free stability model, M1 = constrained stability model, M2 = normal effect model, M3 = reversed effect model, M 4 = reciprocal effect model. RMSEA = root mean square of approximation, SRMR = standardized root mean square residual [values ≤ 0.08 indicate a good data fit]; TLI = Tucker Lewis Index, CFI = Comparative Fit Index [values close to 0.95 indicate a good fit of the model (Hu & Bentler, 1999)]. * $p < .05$, ** $p < .01$.

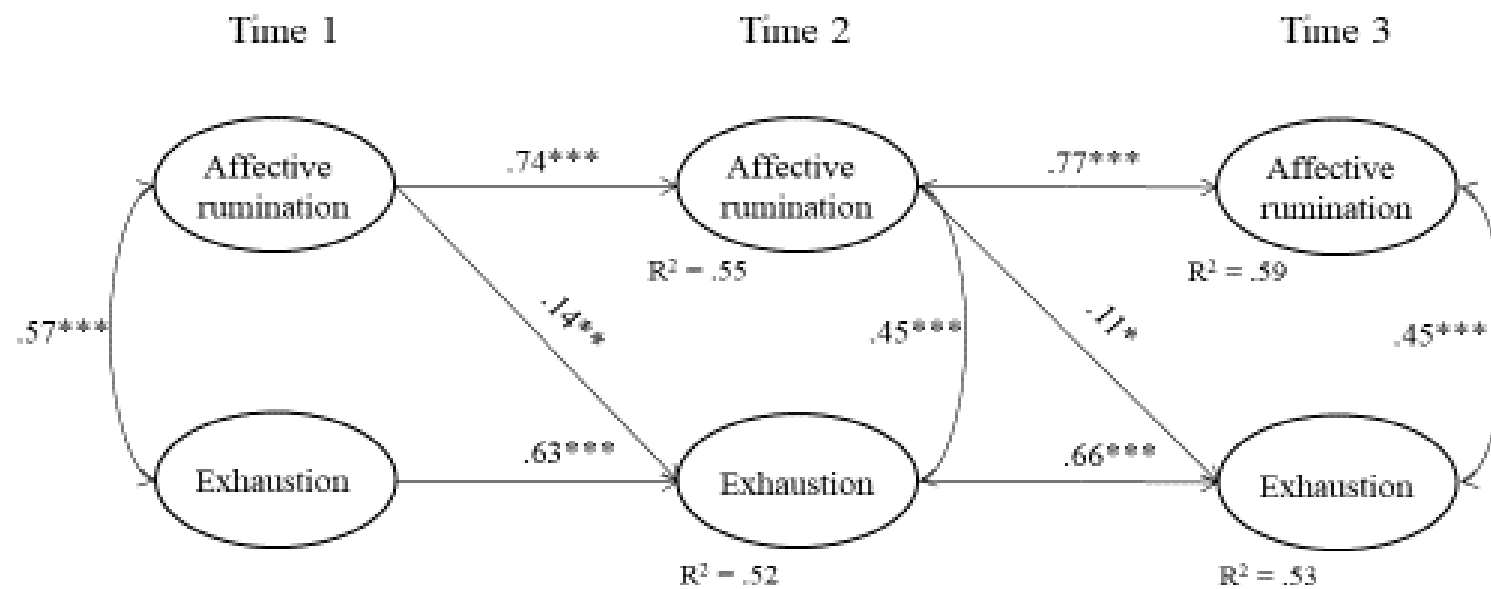


Figure 1a. Affective work-related rumination predicts job exhaustion across 1 year from T1 to T2 and from T2 to T3 follow-up (normal effects model based on three measurement points)

Notes. Time pressure at T1 controlled for in the analyses. Only significant relationships shown.

* $p < .05$, ** $p < .01$, *** $p < .001$.

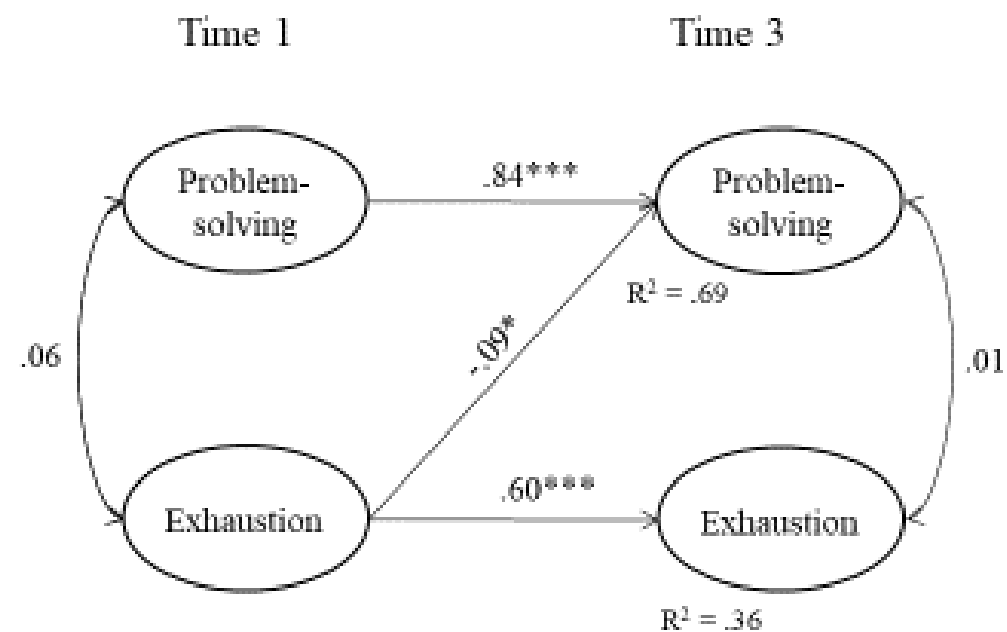


Figure 1b. Job exhaustion predicts problem-solving pondering across 2 years from T1 to T3 (reversed effect model based on two measurement points)

Notes. Time pressure at T1 controlled for in the analyses. Only significant relationships shown. * $p < .05$, *** $p < .001$.

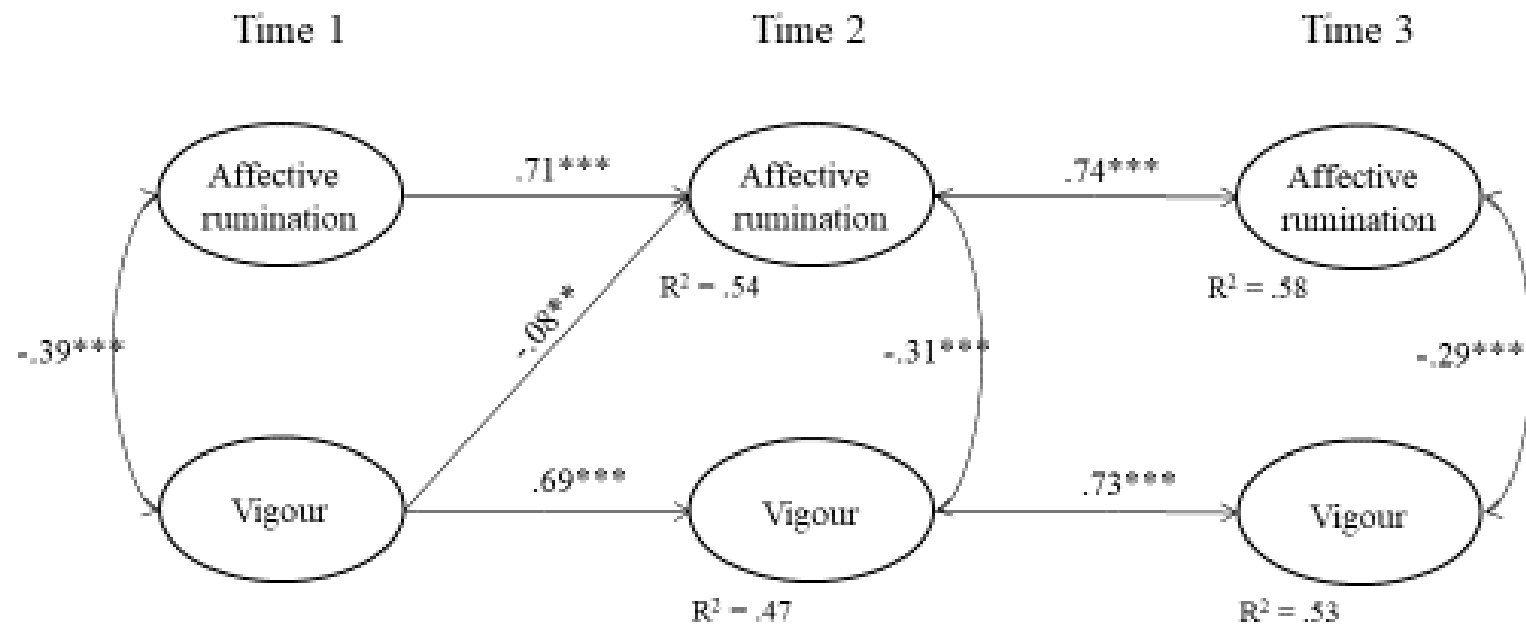


Figure 2a. Vigour predicts affective work-related rumination across 1 year from T1 to T2 (reversed effect model based on three measurements)

Notes. Time pressure at T1 controlled for in the analyses. Only significant relationships shown. $** p < .01$, $*** p < .001$.

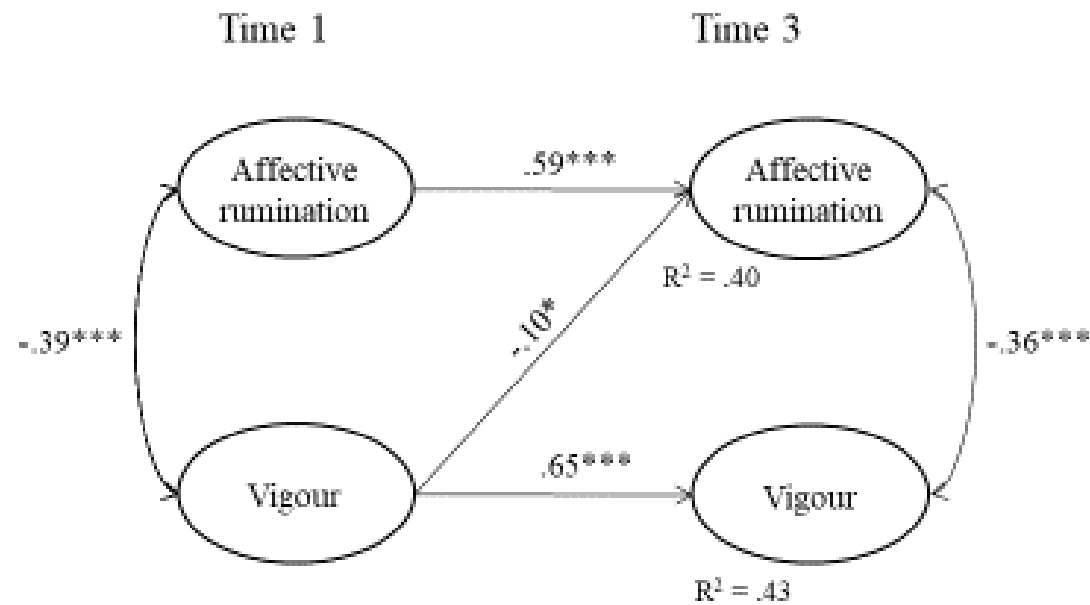


Figure 2b. Vigour predicts affective work-related rumination across 2 years from T1 to T3 (reversed effect model based on two measurement points)

Notes. Time pressure at T1 controlled for in the analyses. Only significant relationships shown. $^* p < .05$, $^{***} p < .001$.

Appendix: Table 1
Summary of Hypotheses Testing

Hypotheses	Supported for time lag	
	across 1 year	across 2 years
H1a. Affective rumination is positively related to job exhaustion	yes	no
H1b. Job exhaustion is positively related to affective rumination	no	no
H1c. Affective rumination is positively related to job exhaustion and simultaneously job exhaustion is positively related to affective rumination	no	no
H2a. Affective rumination is negatively related to vigour	no	no
H2b. Vigour is negatively related to affective rumination	yes	yes
H2c. Affective rumination is negatively related to vigour and simultaneously vigour is negatively related to affective rumination	no	no
H3a. Problem-solving pondering is negatively related to job exhaustion	no	no
H3b. Job exhaustion is negatively related to problem-solving pondering	no	yes
H3c. Problem-solving pondering is negatively related to job exhaustion and simultaneously job exhaustion is negatively related to problem-solving pondering	no	no
H4a. Problem-solving pondering is positively related to vigour	no	no
H4b. Vigour is positively related to problem-solving pondering	no	no
H4c. Problem-solving pondering is positively related to vigour and simultaneously vigour is positively related to problem-solving pondering	no	no
H5a. Lack of psychological detachment is positively related to job exhaustion	no	no
H5b. Job exhaustion is positively related to lack of psychological detachment	no	no
H5c. Lack of detachment is positively related to job exhaustion and simultaneously job exhaustion is positively related to lack of detachment	no	no
H6a. Lack of psychological detachment is negatively related to vigour	no	no
H6b. Vigour is negatively related to lack of psychological detachment	no	no
H6c. Lack of detachment is negatively related to vigour and simultaneously vigour is negatively related to lack of detachment	no	no